

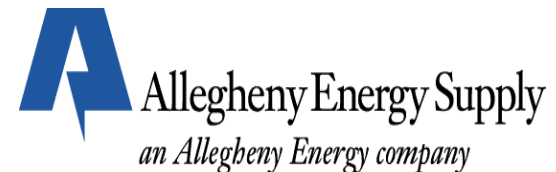
Combustion Technology: Utility Perspectives on Research and Development Needs

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About Allegheny Energy

- 125 year old company – began supplying power in 1883
- Two Core businesses: Allegheny Energy Supply and Allegheny Power
- Over 1.7 million customers for electricity
- Generation mix includes
 - Coal [65.4%]
 - Natural gas [24.8%]
 - Oil [1.3%]
 - Hydro and pumped storage [8.4%]



Allegheny Energy

- Supplies customers in
 - Pennsylvania
 - West Virginia
 - Maryland
 - Virginia
 - Ohio
- Generation Locations
 - Pennsylvania
 - West Virginia
 - Maryland
 - Virginia
 - Tennessee
 - Indiana
 - Illinois

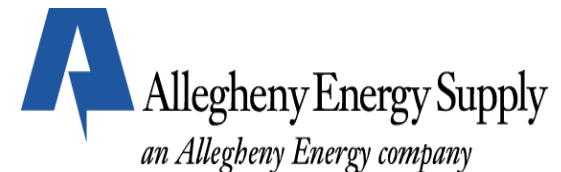


Allegheny Energy Supply and Deregulation

- Over 12,000 MWe of total generation capacity (as of Dec 31, 2001) including 12 stations with coal-fired capacity
- Over 9,900 MW of capacity is unregulated/deregulated
- About 2,100 MW of capacity is regulated
- Coal Boilers are a mix of wall, tangential, cell, vertical and cyclone boiler types

Allegheny Reflects Competitive Conditions Throughout Utility Industry

- Faced with competition and state-based deregulation
 - Generation competition
 - Most plants are now merchant plants
 - Must compete in marketplace
 - Supplier competition for retail customers
 - Default Service is provided by Allegheny Power
 - Special requirements (e.g., portfolio standards, system benefits charges)
- Faced with competitors who did not invest in R&D, but capitalized on utility R&D (IPP's, NUG's)

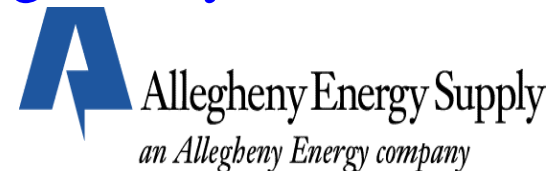


Allegheny Reflects Regulatory Conditions Throughout Utility Industry

- Increased environmental regulations
 - NO_x regulations
 - Multi-pollutant regulations (NO_x, SO₂, mercury, CO₂, other)
- Periodic conflicts between Federal and state regulators

Allegheny Reflects Business Conditions Throughout Utility Industry

- Fleet of coal-fired stations is getting older (20 – 50 year old boilers)
 - No longer burning original spec coal
 - Burning least cost fuels—including fuel blends and opportunity fuels
- No longer putting generation costs in rate base
- Faced with investor skepticism due to financial market news – less money available for projects.
- Fuel adjustment clauses- saving or losing money on fuel no longer flows to the customer



Summary of Utility Conditions

- Competition to generate and supply power
- Generating while a capacity surplus remains
- Generating with competitive fuels in a tight market environment
- Can't recover all research costs in rate base
- Less money available for R&D

Utility Conditions - 2

- Reduced investment in R&D
 - Much less collaborative research, and total research, due to competition
- Less emphasis on doing things “because it is the right thing to do” – loss of rate base coverage
- Industry now has large debt and financial difficulties, no longer BAU, simply survival and expectation of major cost cutting measures, reduced staffs, little to no new construction unless absolutely necessary
- Focus on existing Asset Optimization and Risk Management

Government/Academic R&D Needs and Opportunities

- Now operating generating stations in “tighter” fashion
 - Emphasis on efficiency and emissions
 - Less tolerance for error
- Need research that facilitates better operation and maintenance of existing plants as well as breakthroughs on new generating technologies

Requirements for Academic Programs

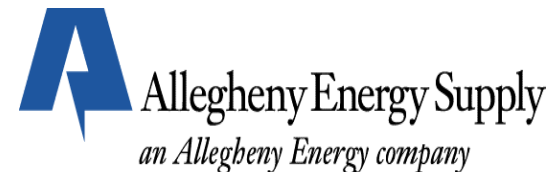
- Get closer to the generating stations
 - Be there, go there
 - Seek practical results in response to real problems
 - Don't get in the way of operations while working there
- In university laboratories
 - Develop larger test facilities
 - Develop results that readily adapt to full scale operations
 - Develop results in response to industry/generating station problems

Examples of Good Programs

- Outreach to generating stations and industry
 - Pennsylvania State University Energy Institute
 - Lehigh University Energy Research Center
- Large scale test facilities
 - University of Utah [e.g., L-1500 test furnace for pulverized coal, fluidized bed furnace, stoker boiler]

Opportunities for Universities

- Collaboration with vendors – large scale test facilities and programs
 - Advanced Combustion Engineering Research Center (ACERC) of University of Utah and Brigham Young University is an example with great potential
- Experimentation with scalable results
- Students working in power plant environments on research



Opportunities for Universities

- Focus more on experimentation – particularly large-scale experimentation
- Use modeling as a tool, and not as the focus of all activities
 - Make modeling practical
 - Develop and ensure experimental and field to model relationships

Opportunities for Universities

- Modeling
 - Separate explanatory modeling from predictive modeling
 - Focus on getting explanatory modeling reasonably precise
 - Develop predictive modeling based upon field test results – and remain tied to full scale results
- Modeling is only one tool: others need to be developed
- Make sure modeling is real, and results are readily usable in commercial practice
- Examples include: CFD, Optimization, Simulation/Emulation, ANN

Opportunities for Universities

- Focus research on shorter term gains
- Understand that Utility Focus is on Financial Performance in the next Quarter
- If doing fundamental research
 - Develop links between fundamental research and full scale applications
 - Show relationships and how industry can use the fundamental research results
 - Develop a Commercialization Model



Issues to Consider

- Conflicting agendas
 - e.g., confidentiality of results [for industry] vs need to publish [for universities]
 - e.g., criticality of budgets and schedules [for industry] vs investigations into new and uncharted areas of interest [for universities]
 - e.g., student time allocation is first to studies, then to solving industry problems vs need for results
- Conflicting time horizons [shorter for industry than academia]
- Potential for project failure

Conclusion

- Optimal division of responsibilities: industry, government, academia:
- Industry – defines the problems to be addressed, provides some seed money for research, needs a business plan or model
- Government – provides bulk of research funding and project management skills consistent with national policies; provides links between industry and academia
- Academia – provides bulk of researchers to address problems, linked with industry and government personnel: